Measurement Method of Multi-layer Piezoelectric Polarity-inverted Structure Using Scanning Nonlinear Dielectric Microscopy

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Recently, ultrasonic devices such as surface acoustic wave and bulk acoustic wave filters and sensors using ferroelectric and/or piezoelectric thin films have been developed combined with micro electro mechanical system (MEMS) technology. In order to improve the device performance, a polarity-inverted structure is one option to be used in the next stage. On that background, it has been reported that polarity of ZnO and AlN piezoelectric thin film fabricated by radio frequency (RF) magnetron sputtering method can be switched by changing the growth condition, and polarity-inverted structure has been obtained [1]. That technique is applicable to MEMS process, and will be able to apply multi-layer structure so that high performance piezoelectric devices will be realized.

Previously, we have proposed the quantitative method for measuring the thickness of a polarity inverted layer in ferroelectric or piezoelectric thin film [2], [3]. It is performed by surface measurement using scanning nonlinear dielectric microscopy (SNDM) non-destructively [4]. In this paper, we expand it to the multilayer and evaluate the depth profile of the multi-layer structure. We will describe a principle of the measurement and relation between the output signal of SNDM and thickness of the inverted layers, which is related to tip radius of the probe. Also, we will show an experimental result in multi-layer piezoelectric thin films.

References

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